CLAIMS

What is claimed is

1. A optical module comprising at least one gain element and one optical element, said optical element having at least one high index contrast waveguide and at least one mode converter optically connecting said at least one high index contrast waveguide to an external fiber, wherein said at least one mode converter and said at least one high index contrast waveguide are monolithically integrated with each other.

2. The optical module of claim 1, further comprising a second mode converter, said second mode converter optically connecting said at least one high index contrast waveguide to the at least one gain element; said second mode converter and said high index contrast waveguide are monolithically integrated with each other.

3. The optical module of claim 2, wherein said second mode converter includes a tapered tip formed on said at least one high index contrast waveguide.

4. The optical module of claim 3, wherein said tapered tip is one of adiabatic and linear.

5. The optical module of claim 3, wherein said tapered tip is oriented towards said gain medium.

6. The optical module of claim 1, wherein said at least one high index contrast waveguide is optically connected to the at least one gain element, and said at least one of said high index contrast waveguide is mode matched to said gain element.

7. The optical module of claim 1, wherein said at least one high index contrast waveguide is optically connected to at least one grating to form an external cavity laser.

8. The optical module of claim 7, further comprising at least one low index waveguide optically connected to said at least one high index waveguide, wherein the at least one grating is formed on the at least one low index contrast waveguide.

9. The optical module of claim 7, further comprising an at least one second mode converter, the at least one second mode converter being optically coupled between the at least one low index contrast waveguide and at least one high index contrast waveguide.

10. The optical module of claim 1, further comprising at least one filter for wavelength selection, the at least one filter being formed on said at least one high index contrast waveguide to form an external cavity laser.

11. The optical module of claim 10, wherein said at least one filter includes at least one ring resonator.

12. The optical module of claim 11, wherein said at least one ring resonator is tunable to provide wavelength tuning of the external cavity laser.

13. The optical module of claim 1, wherein the at least one gain element consists of multiple gain regions, and a respective corresponding at least one mode converter being optically connected between a respective gain region and a respective corresponding at least one high index contrast waveguide.

14. The optical module of claim 13, wherein said each of said respective gain regions is locked to a respective different wavelength to form a WDM transmitter.

15. The optical module of claim 14, further comprising a multiplexer optically coupled to each of said at least one high index contrast waveguide, wherein said multiplexer multiplies the respective different wavelengths, said multiplexer being monolithically integrated to said optical element.

16. The optical module of claim 1, wherein the optical element further comprises at least one filter optically connected to said high index contrast waveguide, a filtered wavelength of said filter being a lasing wavelength of said at least one gain element to clamp a constant gain of said at least one gain element to produce a constant gain in an output signal of said optical module.

17. The optical module of claim 16, wherein said optical module is an amplifier and said amplifier is biased well above a threshold so that a gain of said at least

one gain element is substantially at equilibrium with a loss through an external cavity formed by said filter and gain medium.

18. The optical module of claim 16, wherein said at least one filter includes at least one ring resonator formed on said high index contrast waveguide.

19. The optical module of claim 16, wherein at least one of said at least one filter includes at least one grating.

20. The optical module of claim 1, wherein said optical module is a wavelength converter.

21. The optical module of claim 20, wherein said gain element is biased at at least a threshold, so that an input at a predetermined wavelength is converted to an output of a different wavelength.

22. The wavelength converter of claim 20, further comprising a respective input port to each of said at least one gain element, and a respective output port from each of said at least one gain element, wherein a continuous wave input having a wavelength λ_1 and a modulated input having a wavelength λ_2 are input at said input port of said gain element, and a modulated output at said output has a wavelength λ_1.

23. The wavelength converter of claim 22, wherein modulated input of wavelength λ_2 is converted by cross gain modulation to a modulated output at a lasing wavelength of said amplifier without the use of a continuous wave signal.